CLAIMS

What is claimed is:

1. A communication system for transmitting and receiving digital data comprising:
a transmitter transmitting one or more digitally gated carrier waves gated by said digital data and
a receiver detecting at least one digitally gated carrier wave of the one or more digitally gated carrier waves,
wherein said receiver determines a state of said digital data by counting cycles of the at least one digitally gated carrier wave of the one or more digitally gated carrier waves.

2. The communication system according to Claim 1, wherein at least one digitally gated carrier wave has a frequency in the less than microwave, microwave, millimeter wave, or optical spectrum and is radiated in free space from said transmitter to said receiver.

3. The communication system according to Claim 1, wherein at least one digitally gated carrier wave has a frequency in the less than microwave, microwave, millimeter wave, or optical spectrum and is directed from said transmitter to said receiver by one or more guided wave devices.

4. The communication system according to Claim 1, where said transmitter comprises:
a carrier wave generator; and
a digital gating device coupled to said carrier wave generator and controlled by said digital data, said digital gating device gating a carrier wave from said carrier wave generator on and off according to a state of the digital data.

5. The communication system according to Claim 4, wherein said transmitter further comprises a power amplifier disposed at said output of said digital gating device and coupled to at least one transmit antenna.

6. The communication system according to Claim 5, wherein said power amplifier is operated in a non-linear region of operation.

7. The communication system according to Claim 4, where said carrier wave generator comprises:
a multi-tone optical generator and
a photo detector receiving a multi-tone optical signal from said multi-tone optical generator,
wherein at least two tones from said multi-tone optical generator are separated in frequency by a desired frequency for said carrier wave.

8. The communication system according to Claim 7, wherein said multi-tone optical generator is located remotely from said digital gating device, said multi-tone optical generator being controlled by a network operations center.

9. The communication system according to Claim 8, wherein said network operations center controls said tones of said multi-tone optical generator.

10. The communication system according to Claim 9, wherein said network operations center controls said tones of said multi-tone optical generator according to a data rate of said digital data.

11. The communication system according to Claim 1, where said transmitter comprises:
a multi-tone optical generator generating at least two optical tones separated in frequency by a desired carrier frequency;

an optical modulator controlled by said digital data, said optical modulator gating one of said two optical tones on and off according to a state of said digital data; and

a photodetector receiving said at least two optical tones.

12. The communication system according to Claim 1, wherein the presence of a specified number of cycles in said at least one digitally gated carrier wave indicates a first state of said digital data and the absence of a specified number of cycles in said at least one digitally gated carrier wave indicates a second state of said digital data and said receiver comprises digital counting circuitry counting the number of cycles present in and counting the number of cycles absent from said at least one digitally gated carrier wave.

13. The communication system according to Claim 12, wherein said receiver additionally comprises:

a receive antenna;

a low noise amplifier coupled to said receive antenna;

a limiter circuit coupled to an output of said low noise amplifier and providing an output to said digital counting circuitry; and

a digital signal processor receiving an output from said digital counting circuitry.

14. The communication system according to Claim 1, wherein said transmitter transmits said gated carrier wave at a first polarization for a first state of said digital data and transmits said gated carrier wave at a second polarization for a second state of said digital data.

15. The communication system according to Claim 1, wherein said transmitter comprises:

a carrier wave generator generating an electrical carrier wave;

a digital gating device coupled to said carrier wave generator and controlled by said digital data, said digital gating device gating the electrical carrier wave on and off according to a state of the digital data; and

an optical modulator generating said at least one digitally gated carrier wave at an optical frequency, said optical modulator being controlled by said electrical carrier wave.

16. The communication system according to Claim 1, wherein said transmitter comprises:

an optical carrier wave generator generating one or more optical carrier waves; and

an optical modulator receiving at least one of the one or more optical carrier waves and gating the at least one optical carrier wave on and off according to a state of the digital data.

17. The communication system according to Claim 1, wherein said at least one digitally gated carrier wave has a frequency at an optical frequency and said receiver comprises:

a photo-detector receiving said at least one digitally gated carrier wave;

digital counting circuitry counting the number of cycles present in and counting the number of cycles absent from said at least one digitally gated carrier wave;

a limiter circuit receiving an electrical output from said photo-detector and providing an output to said digital counting circuitry; and

a digital signal processor receiving an output from said digital counting circuitry.

18. The communication system according to Claim 1, wherein said transmitter selectably generates said at least one digitally gated carrier wave at selectable optical and/or selectable radio frequencies.

19. The communication system according to Claim 18, wherein said transmitter comprises:

an optical source generating two or more optical wavelength division multiplexed carriers;

a demultiplexer receiving said two or more optical carriers and producing a first optical output at a first optical frequency and at least one other optical output at another optical frequency;

an optical modulator receiving the first optical output and controlled by said digital data to produce a gated optical carrier wave; and

a combiner receiving said gated optical carrier wave and said at least one other optical output, wherein an output from said combiner is selectably directed to an optical fiber, a photo-diode, or is radiated in free space.

20. The communication system according to Claim 1, wherein said at least one digitally gated carrier wave is generated at selectable optical and/or selectable radio frequencies and said receiver comprises:

at least one antenna for receiving said at least one digitally gated carrier wave at radio frequencies, and

one or more photo-diodes for receiving said at least one digitally gated carrier wave at optical frequencies.

21. The communication system according to Claim 20, wherein said receiver additional comprises a diode detector coupled to said at least one antenna, wherein said diode detector produces a baseband digital on/off bit format signal.

22. The communication system according to Claim 18, wherein selection of said optical and/or radio frequencies is for coding purposes.

23. A method for transmitting and receiving digital data comprising:

gating one or more carrier waves with said digital data to produce one or more gated carrier waves;

detecting at least one of said one or more gated carrier waves; and

counting cycles of said at least one gated carrier wave to determine a state of said digital data.

24. The method according to Claim 23, wherein said at least one gated carrier wave has a frequency in the less than microwave, microwave, millimeter wave, or optical spectrum and said at least one gated carrier wave is radiated in free space.

25. The method according to Claim 23, wherein said at least one gated carrier wave has a frequency in the less than microwave, microwave, millimeter wave, or optical spectrum and said method additionally comprises directing said into a guided wave device after the gating step and prior to the detecting step.

26. The method according to Claim 23, wherein said gating one or more carrier waves with said digital data comprises:
generating said one or more carrier waves; and
digitally gating at least one of said one or more carrier waves on and off according to a state of the digital data to produce said one or more gated carrier waves.

27. The method according to Claim 26, wherein said method further comprises:
amplifying said one or more gated carrier waves; and
coupling said one or more gated carrier waves to at least one transmitting antenna.

28. The method according to Claim 27, wherein amplifying said one or more gated carrier waves comprises coupling said one or more gated carrier waves to a power amplifier and operating said power amplifier in a non-linear region of operation.

29. The method according to Claim 26, wherein generating said one or more carrier waves comprises:

generating at least one multi-tone optical signal, wherein at least two tones of said at least one multi-tone optical signal are separated in frequency by a desired frequency for said at least one carrier wave; and

photo-detecting said at least one multi-tone optical signal to generate an electrical signal.

30. The method according to Claim 29 wherein said at least one multi-tone optical signal is generated at and controlled by a network operations center.

31. The method according to Claim 30, wherein said network operations center selects the at least tow tones of the multi-tone optical signal.

32. The method according to Claim 31, wherein said at least two tones are selected according to a data rate of said digital data.

33. The method according to Claim 23, wherein gating one or more carrier waves comprises:

generating at least one multi-tone optical signal, wherein at least two tones of said at least one multi-tone optical signal are separated in frequency by a desired frequency for said at least one carrier wave;

gating at least one of said two optical tones one and off according to a state of said digital data; and

photo-detecting said at least two tones to generate an electrical signal.

34. The method according to Claim 23, wherein the presence of a specified number of cycles in said at least one gated carrier wave indicates a first state of said digital data and the absence of a specified number of cycles in said at least one gated carrier wave indicates a second state of said digital data.

35. The method according to Claim 34, wherein detecting at least one of said one or more gated carrier waves comprises:

receiving said at least one gated carrier wave at one or more receive antennas;

amplifying said at least one gated carrier wave received at said receive antenna to produce an amplified gated carrier wave; and

limiting an amplitude of said amplified gated carrier wave.

36. The method according to Claim 23 further comprising:

transmitting at least one gated carrier wave at a first polarization for a first state of said digital data; and

transmitting said at least one gated carrier wave at a second polarization for a second state of said digital data.

37. The method according to Claim 23, wherein gating one or more carrier waves comprises:

generating one or more electrical carrier waves;

digitally gating at least one of said one or more electrical carrier waves on and off according to a state of the digital data to produce one or more gated electrical carrier waves; and

modulating at least one optical carrier wave with at least one of said one or more gated electrical carrier waves to produce said one or more gated carrier waves.

38. The method according to Claim 23, wherein gating one or more carrier waves comprises:

generating one or more optical carrier waves;

digitally gating at least one of said one or more optical carrier waves on and off according to a state of the digital data to produce said one or more gated carrier waves.

39. The method according to Claim 23 wherein at least one gated carrier wave has a frequency in the optical spectrum and detecting at least one of said one or more gated carrier waves comprises:

photo-detecting said at least one of said one or more gated carrier waves to produce a gated electrical signal; and

limiting an amplitude of said amplified gated electrical signal.

40. The method according to Claim 23, further comprising:

selecting at least one optical and/or radio frequency for said one or more gated carrier waves.

41. The method according to Claim 40, wherein gating one or more carrier waves comprises:

generating two or more optical wavelength division multiplexed carriers;

demultiplexing said two or more optical wavelength division multiplexed carriers to produce a first optical output at a first optical frequency and at least one other optical output at another optical frequency;

modulating said first optical output with said digital data to produce a gated optical carrier wave; and

selectably coupling said gated optical carrier wave to a guided wave device or to an optical radiator to radiate said at least one of said one or more gated carrier waves; or

heterodyning said gated optical carrier wave with said at least one other optical output to produce a gated electrical carrier wave; and

radiating said gated electrical carrier wave as said at least one of said one or more gated carrier waves.

42. The method according to Claim 40, wherein detecting at least one of said one or more gated carrier waves comprises:

receiving said at least one gated carrier wave at one or more antennas; or

receiving said at least one gated carrier wave at one or more photo-diodes.

43. The method according to Claim 42, wherein the method additionally comprises coupling said at least one gated carrier wave received at said one or more antennas to a diode detector to produce a baseband digital on/off bit format signal.

44. The method according to Claim 40, wherein the digital data is coded by the selection of said at least one optical and/or radio frequency.

45. An apparatus for transmitting and receiving digital data comprising:
means for transmitting one or more gated carrier waves gated by said digital data and
means for receiving at least one gated carrier wave of the one or more gated carrier waves,
wherein said means for receiving determines a state of said digital data by counting cycles of the at least one gated carrier wave of the one or more gated carrier waves.

46. The apparatus according to Claim 45, wherein at least one gated carrier wave has a frequency in the less than microwave, microwave, millimeter wave, or optical spectrum and is radiated in free space from said means for transmitting to said means for receiving.

47. The apparatus according to Claim 45, wherein at least one gated carrier wave has a frequency in the less than microwave, microwave, millimeter wave, or optical spectrum and is directed from said means for transmitting to said means for receiving by one or more guided wave devices.

48. The apparatus according to Claim 45, where said means for transmitting comprises:
means for generating a carrier wave; and
means for gating, said means for gating coupled to said means for generating a carrier wave and controlled by said digital data, said means for gating gating a carrier

wave from said means for generating a carrier wave on and off according to a state of the digital data.

49. The apparatus according to Claim 48, wherein said means for transmitting further comprises a means for amplifying disposed at said output of said mean for gating and coupled to a means for radiating.

50. The apparatus according to Claim 49, wherein said means for amplifying is operated in a non-linear region of operation.

51. The apparatus according to Claim 48, where said means for generating a carrier wave comprises:

means for generating a multi-tone optical signal and

means for photo-detecting an optical signal, said means for photo-detecting receiving a multi-tone optical signal from said means for generating a multi-tone optical signal,

wherein at least two tones from said means for generating a multi-tone optical signal are separated in frequency by a desired frequency for said carrier wave.

52. The apparatus according to Claim 51, wherein said means for generating a multi-tone optical signal is located remotely from said means for gating, said means for generating a multi-tone optical signal being controlled by a network operations center.

53. The apparatus according to Claim 52, wherein said network operations center controls said tones from said means for generating a multi-tone optical signal.

54. The apparatus according to Claim 53, wherein said network operations center controls said tones from said means for generating a multi-tone optical signal according to a data rate of said digital data.

55. The apparatus according to Claim 45, where said means for transmitting comprises:

means for generating a multi-tone optical signal generating at least two optical tones separated in frequency by a desired carrier frequency;

means for optically modulating, said means for optically modulating controlled by said digital data and gating one of said two optical tones on and off according to a state of said digital data; and

means for photodetecting, said means for photodetecting receiving said at least two optical tones.

56. The apparatus according to Claim 45, wherein the presence of a specified number of cycles in said at least one gated carrier wave indicates a first state of said digital data and the absence of a specified number of cycles in said at least one gated carrier wave indicates a second state of said digital data and said means for receiving comprises means for counting, said means for counting counting the number of cycles present in and counting the number of cycles absent from said at least one gated carrier wave.

57. The apparatus according to Claim 56, wherein said means for receiving additionally comprises:

means for receiving a radiated signal;

means for amplifying, said means for amplifying coupled to said means for receiving a radiated signal;

means for limiting, said means for limiting coupled to an output of said means for amplifying and providing an output to said means for counting; and

means for processing, said means for processing receiving an output from said means for counting.

58. The apparatus according to Claim 45, wherein said means for transmitting transmits said gated carrier wave at a first polarization for a first state of said digital data and

transmits said gated carrier wave at a second polarization for a second state of said digital data.

59. The apparatus according to Claim 45, wherein said means for transmitting comprises:

means for generating an electrical carrier wave;

means for gating, said means for gating coupled to said means for generating an electrical carrier wave and controlled by said digital data, said means for gating gating an electrical carrier wave on and off according to a state of the digital data; and

means for optical modulation, said means for optical modulation controlled by said electrical carrier wave and generating said at least one digitally gated carrier wave at an optical frequency.

60. The apparatus according to Claim 45, wherein said means for transmitting comprises:

means for generating one or more optical carrier waves; and

means for optical modulation, said means for optical modulation receiving at least one optical carrier wave from the means for generating one or more optical carrier waves and gating the at least one optical carrier wave on and off according to a state of the digital data.

61. The apparatus according to Claim 45, wherein said at least one gated carrier wave has a frequency at an optical frequency and said means for receiving comprises:

means for photo-detecting, said means for photo-detecting receiving said at least one gated carrier wave;

means for counting, said means for counting counting the number of cycles present in and counting the number of cycles absent from said at least one gated carrier wave;

means for limiting, said means for limiting receiving an electrical output from said means for photo-detecting and providing an output to said means for counting; and

means for processing, said means for processing receiving an output from said means for counting.

62. The apparatus according to Claim 45, wherein said means for transmitting selectably generates said at least one gated carrier wave at selectable optical and/or selectable radio frequencies.

63. The apparatus according to Claim 62, wherein said means for transmitting comprises:
means for generating two or more optical wavelength division multiplexed carriers;
means for demultiplexing, said means for demultiplexing receiving two or more optical carriers from said means for generating and producing a first optical output at a first optical frequency and at least one other optical output at another optical frequency;
means for optical modulation, said means for optical modulation receiving the first optical output and controlled by said digital data to produce a gated optical carrier wave; and
means for combining, said means for combining receiving said gated optical carrier wave and said at least one other optical output, wherein an output from said means for combining is selectably directed to an optical fiber, a photo-diode, or is radiated in free space.

64. The apparatus according to Claim 45, wherein said at least one gated carrier wave is generated at selectable optical and/or selectable radio frequencies and said means for receiving comprises:
means for receiving a radiated electrical signal, said means for receiving a radiated electrical signal said at least one gated carrier wave at radio frequencies, and
means for photo-detection, said means for photo-detection receiving said at least one gated carrier wave at optical frequencies.

65. The apparatus according to Claim 64, wherein said means for receiving additional comprises a diode detector coupled to said means for receiving a radiated electrical signal, wherein said diode detector produces a baseband digital on/off bit format signal.

66. The apparatus according to Claim 45, wherein means for transmitting comprises means for selecting one or more optical and/or selectable radio frequencies for said at least one gated carrier wave based on a desired coding.

67. A digital transmitter for transmitting digital data comprising:
a carrier generator providing one or more carrier signals at selected frequencies;
a serializer coupled to said digital data and producing a serial stream of digital bits;
a data edge synchronizer coupled to said serial stream of digital bits and receiving at least one carrier signal of said one or more carrier signals, said data edge synchronizer producing a synchronized stream of digital bits, wherein at least one edge of each digital bit in said synchronized stream of digital bits is synchronized to a specified part of each cycle within said at least one carrier signal; and
a gating circuit gating at least one carrier signal of said one or more carrier signals according to each digital bit in said synchronized stream of digital bits.

68. The digital transmitter according to Claim 67, wherein said data edge synchronizer comprises:
one or more wide-band limiting amplifiers coupled to said serial stream of digital bits; and
a flip-flop coupled to an output of said one or more wide-band limiting amplifiers.

69. The digital transmitter of Claim 68, wherein said flip-flop comprises a latch or D flip-flop.

70. The digital transmitter of Claim 67, wherein said gating circuit gates said at least one carrier signal on and off.

71. The digital transmitter of Claim 67 wherein said gating circuit selects one carrier signal of said one or more carrier signals and gates the selected carrier signal.

72. The digital transmitter of Claim 67, wherein said gating circuit gates said at least one carrier signal according to each digital bit in said synchronized stream of digital bits and according to a specified code sequence.

73. A digital receiver for receiving a carrier signal gated by digital data:
an amplifier receiving said carrier signal and providing an amplified signal;
a limiting circuit coupled to said amplifier, said limiting circuit receiving said amplified signal and providing a limited signal; and
a divider/counter coupled to said limiting circuit, said divider/counter counting a number of consecutive periods present or absent in said limited signal to provide a digital output.

74. The digital receiver of Claim 73, said digital receiver further comprising a synchronizing circuit, said synchronizing circuit generating a local oscillator signal based on a frequency of said carrier signal.

75. The digital receiver of Claim 74, wherein said divider/counter comprises:
a divider coupled to said limiting circuit, said divider providing a divider signal to said synchronizer circuit, wherein said local oscillator signal is based on said divider signal; and
a counter receiving said divider signal and counting a number of consecutive periods present or absent in said divider signal to provide a digital output.

76. The digital receiver of Claim 75, wherein a relationship between the frequency of said carrier and a number of carrier cycles corresponding to a data bit is specified and said divider and said counter are configured according to the specified relationship.

77. The digital receiver of Claim 76, wherein said specified relationship is changeable.

78. A method for transmitting digital data comprising:
generating at least one carrier signal;
converting said digital data to a stream of serial digital bits;
synchronizing said stream of serial digital bits to said at least one carrier signal to generate a synchronized stream of digital bits such that at least one edge of each digital bit in said synchronized stream of digital bits is synchronized to a selected part of each cycle within said at least one carrier signal; and
gating said at least one carrier signal according to each digital bit in said synchronized stream of digital bits.

79. The method according to Claim 78, wherein synchronizing said stream of serial digital bits comprises:
amplifying said stream of serial digital bits to generate an amplified stream of serial digital bits;
limiting said amplified stream of serial digital bits to generate a limited stream of serial digital bits;
coupling said limited stream of serial digital bits to a latch or D-type flip-flop; and
clocking said latch or D-type flip-flop with said at least one carrier signal to generate said synchronized stream of digital bits.

80. The method according to Claim 78, wherein at least one carrier signal comprises a plurality of carrier signals and said gating comprises gating a selected one or more of said plurality of carrier signals.

81. The method according to Claim 78, wherein said gating additionally comprises gating said at least one carrier signal according to a selected code sequence.

82. A method for receiving a carrier signal gated by digital data comprising:
generating a synchronized clock signal based on said carrier signal;
comparing said carrier signal to said synchronized clock signal;
counting a number of consecutive periods present in or absent from said carrier signal based on the comparison of said carrier signal to said synchronized clock signal;
determining a state of a digital bit based on the count of consecutive periods; and
providing a serial stream based on the determined state of each digital bit.

83. The method according to Claim 82, wherein the count of consecutive periods for a state of a digital bit is related to a frequency of the carrier signal.

84. The method according to Claim 82, wherein the method further comprises converting said serial stream to a parallel output.

85. The method according to Claim 82, wherein said digital data has a header that defines the number of consecutive periods used to determine a state of a digital bit.